

LIFE-HISTORY OF A EUROPEAN SLUG CATER- PILLAR, COCHLIDION AVELLANA.

PLATE V.

BY HARRISON G. DVAR, A.M., PH.D.

Cochlidion avellana Linn.

1758. *Tortrix avellana* LINNÆUS, Syst. Nat. I, 531.
 1761. *Tortrix avellana* LINNÆUS, Faun. Suec. 334.
 1767. *Bombyx limacodes* HUFNAGEL, Berl. Mag. III, 402, 425.
 1777. *Bombyx sulphurea* FABRICIUS, Gen. Ins. 279.
 1780. *Phalena limax* BORKHAUSEN, Eur. Schmett. III, 449.
 1784. *Bombyx limacodes* ESPER, Schmett. III, 140, pl. 26, figs. 3 to 9.
 1787. *Bombyx bufo* FABRICIUS, Mant. Ins. II, 121.
 1787. *Bombyx testudo* FABRICIUS, Mant. Ins. II, 121.
 1794. *Phalena funalis* DONOVAN, Brit. Ins. III, 76.
 1801. *Bombyx avella* ESPER, Schmett. III (1) 36, pl. 85, fig. 4.
 1803. *Tortrix testudinana* HÜBNER, Eur. Schmett. Tortr. figs. 164, 165.
 1806. *Cochlidion testudo* HÜBNER, Tentamen, 2.
 1809. *Apoda testudo* HAWORTH, Lep. Brit., II, 137.
 1822. *Limacodes testudo* GODART, Lep. France, IV, 279, pl. 28, figs. 1, 2.
 1825. *Limacodes testudo* LATREILLE, Fam. Nat. 474.
 1829. *Limacodes testudo* STEPHENS, Ill. Brit. Ent. Haust. II, 86.
 1830. *Tortrix testudinana* TREITSCHKE, Schmett. Eur. VIII, 14.
 1855. *Limacodes testudo* WALKER, Cat. Brit. Mus. V, 1145.
 1858. *Limacodes testudo* RAMBUR, Cat. Lep. And. 340, note.
 1871. *Heterogenea limacodes* STAUDINGER, Cat. Lep. Eur., 62.
 1892. *Apoda avellana* KIRBY, Cat. Lep. Het. I, 552.
 1896. *Apoda limacodes* GROTE, Syst. Nord. Schmett.

LARVA.

1776. SCHIFFERMILLER, Syst. Verz. Wiener Geg. pl. 18, fig. 17.
 1787. FABRICIUS, Mant. Ins. II, 121.
 1800. SEPP, Nederland. Ins. II, 15.
 1810. HÜBNER, Samml. Eur. Schmett. VI, 6a.
 1835. TREITSCHKE, Schmett. Eur. VIII, 15.
 1861. WILDE, Syst. beschr. Raup. 70.
 1886. BUCKLER, Larv. Brit. Moths, III, 53.
 1893. HOFMANN, Raup. Gross Schmett. Eur. pl. 18, fig. 17, end plate, fig. 35.
 1894. CHAPMAN, Tr. Ent. Soc. Lond. 345, pl. VII, figs. 14 to 20.

SPECIAL STRUCTURAL CHARACTERS.

Dorsal space broad, narrowing slightly toward the extremities, ending behind in the quadrate, slightly notched joint 13; not strongly

arched. Lateral space broad, oblique, slightly concave, narrowing a little toward the extremities. Subventral space very small, contracted. Subdorsal ridge at first prominent, finally smooth, not elevated. Lateral and subventral ridges moderately prominent, approximate, the lateral at first tubercular, later smooth. Warts single haired; in stage I the subdorsal now bears two spines on joints 3 and 13, a single spine with short branch about the middle on joints 4 to 12, leaning in alternating directions; later the warts are represented by tubercles bearing two setæ on subdorsal ridge and on the central thoracic wart, one seta on lateral ridge; in the last stage obliterated. Subventral setæ rudimentary, but persistent. Depressed areas moderately well developed, rather small, rounded, slightly sunken, not very sharply defined, smooth. The series (1) to (8) are present. Skin at first smooth, later covered with papillose granules which become converted into round granules with irregular divided crests or numerous thick spinules and in the last stage with dense, round, clear granules of unequal size. After the last molt the larva becomes very smooth but there is no distinct change in coloration, the ancestral yellowish green persisting. The larva is marked like the leaves, adapted to escape observation.

AFFINITIES, HABITS, ETC.

This larva is allied to *C. y-inversa* Pack. as pointed out by Miss Morton and myself (Journ. N. Y. Ent. Soc., III, 152), but it differs in some interesting particulars that I did not suspect from the examination of my former material. It is in several respects more generalized. The color remains yellowish green nearly to the end, not becoming suffused with white pigment as in *y-inversa*; the outline of the lateral ridge is slightly waved; there is frequently a red border to the transverse yellow line on joint 3 and the granules before the last stage have irregular crests. In all these characters the larva departs from *y-inversa* and approaches *Heterogenea*. There is no dorsal red patch, as is characteristic in that genus, yet there is a distinct tendency to the production of red color in the edge of the collar and the dark dots of the subdorsal line. The condition of the granules is especially interesting, for it explains the origin of the "fur" of *Heterogenea*, by the splitting up of the apex of a papillose granule into short thick spines which become borne on the crest of the granule and may easily be imagined further modified into the "fur" structure by becoming slender and more attenuated. The larva belongs to the group of palæ-

arctic smooth Euclidean which extends through northern Europe, Asia and America, reaching to the mountainous parts of India and in America even southward to the tropics in the case of one species.* *C. avellana* is European, but its nearest ally is the North American species above referred to (*γ-inversa*). In certain respects the American *Lithacodes fasciola* is also a closely allied larva.

The eggs are laid singly, the larvæ feed on the backs of the leaves and have a single brood in the year, all apparently as in the allied forms. As I have no experience with the larva in a wild state, I will not enter further into this subject, but refer to the European literature. The material from which this life history was worked out was obtained from Staudinger and Haas, of Dresden, Germany.

CRITICISM OF PREVIOUS DESCRIPTIONS.

The early figures are more or less successful attempts at reproducing the general appearance of the full grown larva, natural size. Dr. Chapman gives some very full and interesting observations on Stage I, especially in regard to the evagination of the spines on hatching, and an accurate enlarged figure. This evagination occurs in all the larvæ that have the primitive first stage. I think it can be shown that the setæ of the evaginated tubercles are absent and that it is the spine-like tubercle that is thus modified.† Setæ iv and v are true setæ and are not evaginated, besides being much slenderer and different in appearance from these stiff spines. The supposition that the spines are tubercles also explains the coalescence of the subdorsal ones (i and ii) into a single organ which is far advanced in this species, but goes even further in *Packardia* and reaches the maximum in *Phobctron*.

I have already referred (Journ. N. Y. Ent. Soc., III, 152, note) to Dr. Chapman's mistake in considering the apparent dislocation of the subdorsal tubercles as evidence that they represented two rows as in *Erioccephala*, and to my disagreement with the generalization he has made. Stage I, in these Cochlidiæ, is only a primitive first stage with tubercles i to v present, arranged as in the highest "micro" type, but further modified by the absence of setæ on tubercles i to iii, the

* *Lithacodes fasciola*. See Schaus, Proc. Zool. Soc. Lond., 1896, 650 and Walker, Tr. Ent. Soc. Lond., 1862, 82, said to be from "South America."

† In the Notodontiæ that have hypertrophied tubercles only the primitive setæ are present at birth and the "horns" grow out much as in the Cochlidiæ, but here the true setæ are present and appear on or near the apices of the horns.

enlargement of these tubercles into spines and the alternation of the subdorsal warts on the successive strong and weak segments.* I do not think that Dr. Chapman would have reached any other conclusion if he had had as extensive a fauna in the family as is present in America. The English species consist of only two members of the palæarctic group without any of the others, and it is not surprising that from these only he should have been misled, especially as the homology of the tubercles of the Cochlidions is decidedly involved.

DESCRIPTION OF THE SEVERAL STAGES IN DETAIL.

Egg.—Elliptical, flat as usual, clear, translucent whitish with transparent rim; reticulations obscure; size $1.1 \times .8 \times .1$ mm. Duration six days.

Stage I. (Plate V, Fig. 1.) Head slightly testaceous, eye black, mouth brown; cervical shield blackish brown, covering the head when it is retracted. Body thick, truncate before, narrowed and rounded behind; dorsal and lateral spaces moderate, flat; subventral space retracted. Tubercles large, round, the spines arranged as in the other species of *Cochlidion*, the short limbs of the forked subdorsals (joints 4 to 12) forming a short prominence on the shaft (Plate V, Fig. 2) as in *y-inversa*, not as long as in *biguttata*. The subdorsals of joints 5, 7, 9 and 11 lean outwardly. Spaces a little hollowed intersegmentally both dorsally and laterally. Color whitish, after feeding, becoming pale green from the blood, smooth, shining. Subdorsal ridge white, the lateral ridge less distinctly so; setæ pale with dusky tips. The cervical shield pigment is less than in *C. biguttata*. Length, 1.0 to 1.5 mm.

Stage II. (Plate V, Fig. 4)—Elliptical, truncate, narrowing behind, widest through joints 4 and 5. Dorsal and lateral spaces broad, narrowed at the ends, gradually so posteriorly; sub-ventral space retracted. Ridges prominent, with rounded tubercles, two long black tipped setæ on subdorsal ridge and at middle of joints 3 and 4, one seta on the lateral ridge on joints 3 to 12, normal. Skin remotely finely granular with pale secondary spines on the tubercles, the spines bluntly tipped. The subdorsal setæ still show some of the alternation of stage I, those of joints 5, 7, 9 and 11 leaning outward, but all bear two setæ. Pale green, subdorsal ridge whitish, a black shade under joint 2 at the cervical shield. Length, 1.5 to 2.4 mm.

* I owe the suggestion of strong and weak segments to Dr. Chapman's work on *Acronycta*.

Stage III.—Elliptical, rounded before, tail slightly quadrate and notched; ridges prominent, the lateral a little exceeding the subventral; dorsal and lateral spaces broad, subventral small, retracted. Depressed spaces (1) to (6) all distinct, whitish, (2) somewhat oblique; (7) and (8) indicated as large, smooth hollows. Tubercles moderately large, the lateral the largest, forming the ridges and bearing long, smooth, stiff setæ, blackish at the tips: subventral hairs (iv and v) fine, white, situated on joints 5 to 13. Skin sparsely granular, a few of the granules prolonged into papillæ with cleft tips. These are most numerous on the lateral ridge and the ends of the body. Green, not pigmented, but well colored; a whitish subdorsal line on joints 3 to 13, slightly tinting joint 3 transversely. Depressed spaces (1) to (6) whitish. Later the subdorsal line becomes pale yellow and distinct; but there is no transverse line on joint 3. Length, 2.3 to 3.2 mm.

Stage IV.—Tubercles somewhat less prominent, but still distinct; dorsal and lateral spaces nearly flat. Elliptical, more narrowed behind; tail quadrate, not notched distinctly. Depressed spaces distinct, moderately large, the granules on the latticed ridges more numerous than before, some on the lateral tubercles papillose, not so elsewhere, not forming secondary spines. Setæ large and black tipped. Green, pigmented dorsally as before, depressed spaces whitish, subdorsal line distinct, pale yellow; a transverse pale yellow line on joint 3, not touching the subdorsal lines nor quite reaching the lateral edge; a small white line along subventral edge on joints 5 to 13. In some larvæ the transverse line is edged with salmon color in front. Length, 3.2 to 4.5 mm.

Stage V.—Elliptical, tail quadrate, a little notched at the sides; dorsum slightly arched; tubercles still distinct with stiff, black tipped setæ. Latticed ridges with small not contiguous, clear granules (Plate V, Fig. 8), each somewhat roughened or crested on the vertex (Plate V, Fig. 9), a few of those on the lateral tubercles slightly produced or papillose. Depressed spaces rounded, (1) to (6) all distinctly present, smooth in the bottom. Green, emerald green pigment in dorsal and upper half of lateral spaces; subdorsal line and lateral row of yellow dots; transverse line on joint 3 yellow, salmon tinted before, joining the white subventral line below. Depressed spaces white, (1) and (4) with dark green centers. During the stage a broken dark green line borders the subdorsal above. Length, 4.5 to 6.5 mm.

Stage VI.—As before, the tubercles still distinct, the tail a little notched on the end; setæ nearly if not quite as large as before. Skin granules dense, but not exactly contiguous, round, each with a crown of rough points or tiny granules or roughly tufted centrally (Plate V, Fig. 10); none papillose. The granules cover the tubercles and extend on the bases of the setæ. Yellowish green, depressed spaces all pale yellow, a little paler than the yellow subdorsal line; (4) with round dark centers. The subdorsal line is edged above with dark green; a row of yellow dots on lateral ridge; the transverse line on joint 3 joins the white subventral line as before and is edged before with salmon brown. Subventral space finely granular, spaces (7) and (8) obliquely confluent, not pigmented; setæ iv and v distinct, whitish. Length, 6.3 to 9.1.

Stage VII.—(Plate V, Fig. 11).—Shape as described. Lateral ridge a little segmentarily scalloped, especially posteriorly. Smooth, not shining except on the depressed spaces; skin densely irregularly clear granular, the granules perfectly smooth (Plate V, Fig. 12); tubercles absent, setæ imperceptible except the subventral ones which are about as distinct as before. Head green, jaws and eyes brown, retracted as usual. Body yellowish green, bright green pigment in the dorsal portion, clear green on lateral ridge and below. Subdorsal line yellow, slightly waved, edged above with dark green and centered with a series of dark red segmentary dots; transverse line on joint 3 free from the subdorsals, joining the white subventral line, yellow, edged before more or less with crimson, sometimes distinctly so, the color even traversing the yellow in the center of the dorsum. A row of pale yellow dots on lateral ridge. Depressed spaces pale yellow, (1) and (4) green centered, the center of (1) not a dot, but a transverse slit, showing its paired origin. All the depressed spaces show the glandular dots faintly. Length, 8.5 to 12.5 mm. This stage lasts ten days as in *y-inversa*. On the eighth day the color whitens a little, but only a little and the tint only pales decidedly when the larva loses its hold on the leaf.

Cocoon.—With the characters of the group. Hofmann says it is spun on the leaf and falls to the ground in autumn.

Food-plants.—Hofmann gives oak, beech and chestnut. My larvæ fed readily on the black oak (*Quercus coccinea*).

EXPLANATION OF PLATE V.

- Fig. 1. Larva, stage I, side view, $\times 60$.
 Fig. 2. One of the branched horns (subdorsal tubercles of joints 4 to 12), enlarged.
 Fig. 3. Rear view of the larva, stage I, showing the setæ of the last two segments.
 Fig. 4. Larva, stage II, side view, $\times 40$.
 Fig. 5. One of the lateral tubercles more enlarged, showing setæ and granules.
 Fig. 6. A lateral tubercle, stage III, much enlarged.
 Fig. 7. A subdorsal tubercle of the same stage.
 Fig. 8. A lateral depressed space (4) with skin granules, stage V.
 Fig. 9. The same, some of the granules more enlarged.
 Fig. 10. Skin granules of stage VI, enlarged.
 Fig. 11. Mature larva, stage VII, dorsal view, $\times 5$.
 Fig. 12. Skin granules of stage VII, enlarged.
 Fig. 13. Moth of *Cochlidion avellana*.

A NEW GENUS OF COCHLIDIONIDÆ FROM VIRGINIA.

BY HARRISON G. DYAR.

Isochætes, gen. nov.

Male antennæ shortly bipectinate to the tips, the pectinations longest centrally. Palpi upturned, not reaching the vertex, yet nearly so, evenly, smoothly scaled, third joint distinct, three times as long as wide. Legs slender, front and hind ones sparsely hairy, middle legs densely tufted on tibia and two basal tarsal joints; middle and hind legs with long apical spurs. Venation as in *Phobetron*; primaries with veins 2 and 3 separate, 7 from apex of cell, 8 to 10 stalked, veins all present; secondaries with 6 and 7 stalked, 8 anastomosing with cell to near middle; costa convex; pattern of markings as in *Phobetron*.

I. beutenmülleri Hy. *Edw.*

Male warm ochraceous; thorax and fore wings marked ill-definedly with light brown and dark purplish brown. Hind wings blackish, fringe and abdomen dull ochreous. The pattern of markings recalls that of the female *Phobetron pitheciium*. The ochreous ground color is shaded with pale purplish; a brown, dentate t. a. line on inner half of wing and a short basal streak; a curved t. p. shaded band, traversed by a small U-shaped mark resting on veins 3 and 5, the open end outward; this mark and two dots on the fringe opposite the lower limb of the U, dark purple brown.